

# FIRST RESPONDER INDOOR LOCATION USING LTE DIRECT MODE OPERATIONS

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## Problem Statement

GPS signals **cannot be received indoors**.  
 Indoor location is a difficult problem, but is **critically needed** for emergency first responders.  
 Pre-installed indoor WiFi or beacon transmitter infrastructure may **no longer be available** in an emergency situation.

## Objectives

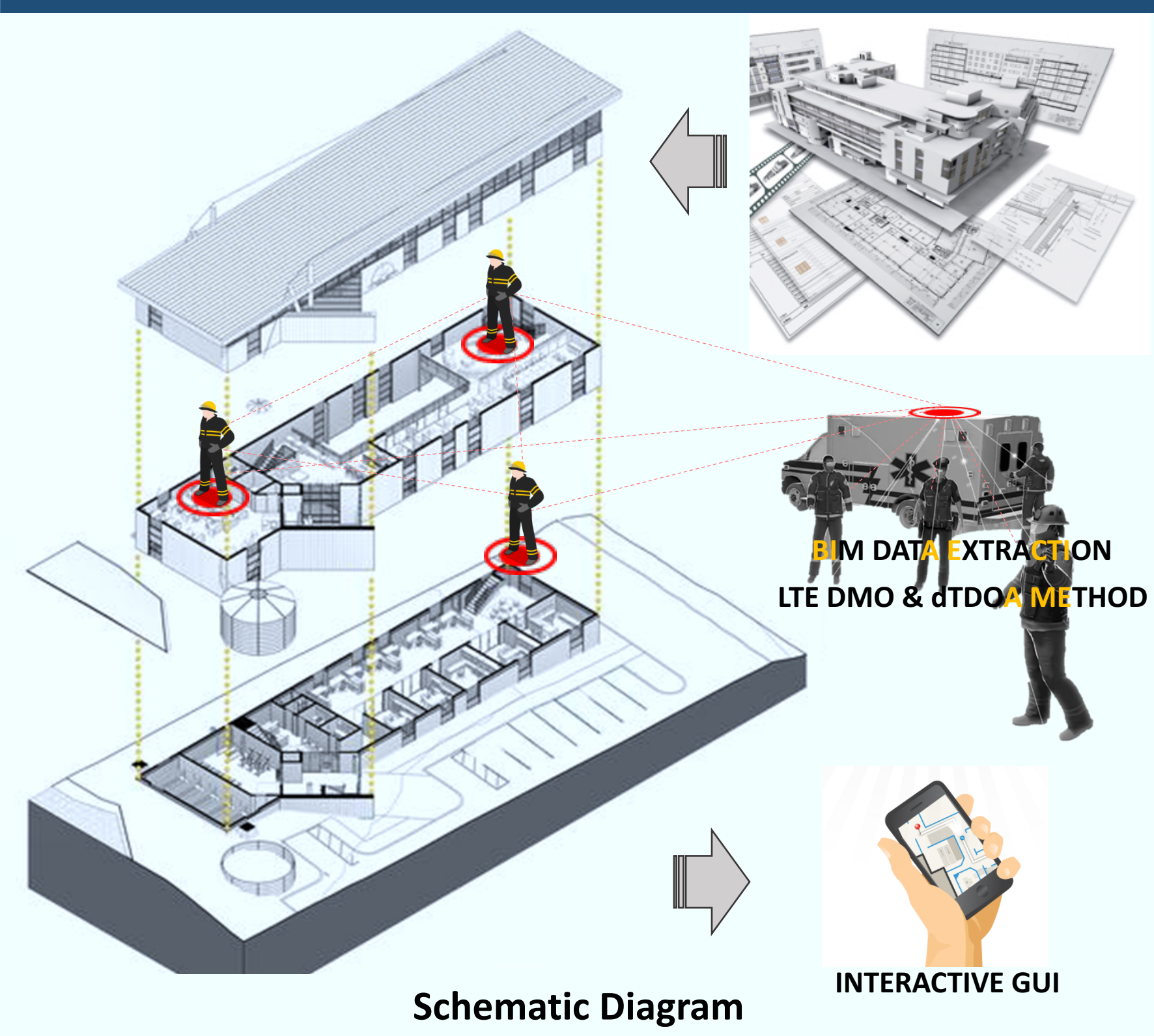
Feasibility study on the concept of **an ad hoc wireless-network-based location service**, leveraging future LTE **D2D voice communication service** of the direct mode operations (DMO) **on the same set of hardware devices**

## Approach

- Use the dTDOA method, with multipath mitigation.
- Design a network communications protocol for 1) **the proposed location service**, 2) **the mission critical voice service** on the *same* LTE devices using the ProSe D2D standard.
- Use standardized **building information modeling (BIM)** such as building interior layout, windows, doors, fire extinguishers, etc. **Display** user locations overlaying on building interior layout.
- Implement** on SDRs, **transmit** over-the-air and **test** inside an actual building.

## Project Schedule

First Responder Indoor Location Using LTE Direct Mode Operations	Year 1				Year 2			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
<b>Tasks</b>								
System design	[Bar]							
Baseband waveform design	[Bar]							
Multipath mitigation							[Bar]	
Comm protocol design			[Bar]					
Location computation			[Bar]					
BIM data investigation	[Bar]							
BIM data extraction			[Bar]					
GUI/display design					[Bar]			
Kalman filter design					[Bar]			
SDR implementation & test					[Bar]			
<b>Milestones</b>								
Milestone with number			1		2		3	
<b>Meetings/Test/Demo</b>								
PSCR Public Safety Board meeting			▲				▲	
System test/demo								▲



## Milestones

- Milestone 1:** Complete baseband waveform design, multipath mitigation (simulation), BIM data investigation.
- Milestone 2:** Complete communications protocol design, location computation, and BIM data extraction.
- Milestone 3:** Complete GUI interface design, Kalman filter design, and SDR implementation.
- Final System Test and Demo:** Final test and demo using an *ad hoc* network of SDRs.

## Expected Impact

- 1) Will **enable location based services on a mission critical voice communications network**, without adding another set of devices.
- 2) Will **help to save cost and reduce size, weight, and power** of devices that a first responder must carry.